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THE WORK OF THE SAN ANTONIO EXPERIMENT FARM IN 1917

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Cotton in the Crop-Rotation Experiments at the San Antonio Experiment Farm

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CONTENTS.

LINES OF WORK.

THE WORK of the San Antonio Experiment Farm was continued during 1917 along the same general lines as in previous years. The rotation and tillage experiments, which are a very important part of the work of the station, were continued without modification. The cooperative work with cotton was continued by the Office of Crop Acclimatization and Adaptation Investigations in the testing of the single-stalk method of culture, the time of thinning cotton when grown by this method, and the breeding and selection of improved varieties adapted to conditions peculiar to the San Antonio region. Experiments in the utilization of winter oats and Sudan grass for pasturing cattle were continued.

Other important lines of work are the horticultural experiments, which have to do with the testing of fruit varieties, the testing of introduced fruits likely to be adapted to local conditions, and the testing of resistant stocks suitable for the soils and conditions of the region; the testing of ornamental trees and shrubs, both native and exotic, likely to be adapted to conditions and useful in the ornamentation of home grounds; the testing of varieties of the standard field crops, such as cotton and corn; the testing of varieties of flax and field peas as winter crops; experiments in different methods of culture with cotton and corn; and various related lines of work.

The arrangement of the fields and the location of the experiments in 1917 are shown in figure 1.

AGRICULTURAL CONDITIONS IN THE REGION.

CLIMATIC CONDITIONS.

The climatic conditions during 1917 were very severe. The year was one of extreme drought, the total precipitation being only 13.22 inches. The winter of 1916–17 was cold and dry, resulting in much winter injury to both annual and tender perennial crops. A late freeze on March 5, when the temperature recorded was 17° F., killed to the ground many plants which had not hitherto been severely injured by cold. Many of the trees were in a growing condition and nearly all fruit trees had flowered. This freeze killed to the ground figs, olives, pomegranates, and all citrus trees except citranges. The Rusk citrange showed least damage from freezing, but the growing branches were frozen back several inches. This freeze resulted in a practically complete failure of all fruit crops.

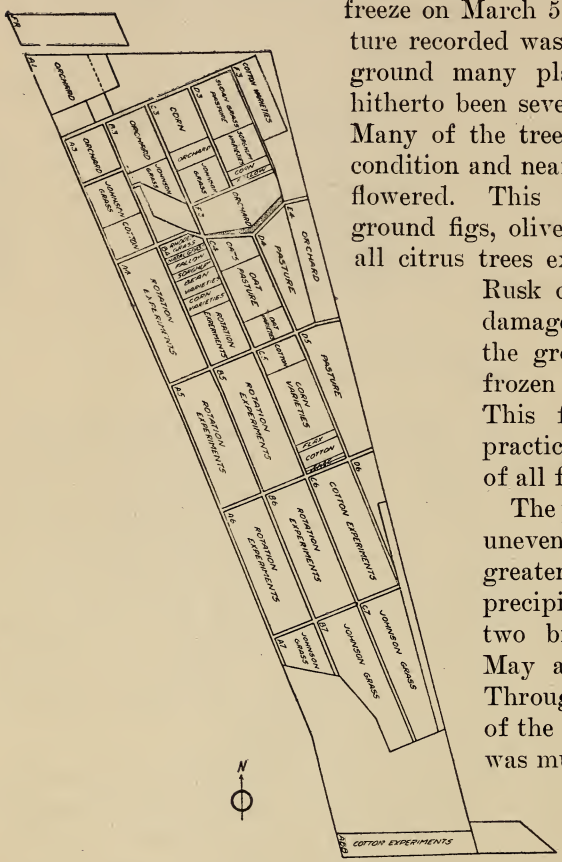

FIG. 1.—Diagram of the San Antonio Experiment Farm, showing the arrangement of the fields and the location of the experiments in 1917.

The precipitation was very unevenly distributed, the greater part of the effective precipitation coming during two brief periods—one in May and another in July. Throughout the remainder of the year the precipitation was much below normal and came in such small showers as to be ineffective so far as its value to crops was concerned. The total evaporation from a free water surface was 76.66 inches, which was somewhat above the average of 68.23 inches for the 11-year period from 1907 to 1917, inclusive.

The minimum temperature during the winter of 1916–17 was 14° F. on February 1. The mean temperature for January was 53° F. The last killing frost in the spring occurred on March 5, and the first in the fall on October 29. The frost was much later in

the spring than usual and also several days earlier than the average in the fall. The frost-free period for the season was 238 days.

The meteorological observations made at the experiment farm are carried on in cooperation with the Biophysical Laboratory of the Bureau of Plant Industry.

Table I gives a summary of these observations for 1917, together with the means for the 11-year period from 1907 to 1917, inclusive.

TABLE I.—*Summary of meteorological observations made at the San Antonio Experiment Farm, 1907 to 1917, inclusive.*

PRECIPITATION (INCHES).

Item.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average for 11 years, 1907 to 1917	0.74	1.62	1.46	3.43	3.03	1.13	1.70	1.85	2.44	2.86	2.45	1.71	24.42
For 1917	.81	.46	.13	.74	3.41	.04	3.40	.32	1.73	1.54	.63	.01	13.22

EVAPORATION (INCHES).

Average for 11 years, 1907 to 1917	2.63	3.23	4.66	5.70	6.69	8.69	9.61	9.01	6.98	5.26	3.24	2.52	68.23
For 1917	2.61	3.99	5.60	7.68	7.56	9.88	9.89	9.81	6.93	6.17	3.63	2.92	76.66

DAILY WIND VELOCITY (MILES PER HOUR).

Highest:													
1911 to 1917	10.4	15.9	11.9	10.6	9.2	11.9	12.1	12.6	6.6	8.5	11.0	8.6	15.9
For 1917	9.8	9.9	11.9	8.8	8.3	6.7	5.7	3.8	4.3	6.3	7.5	8.6	11.9
Lowest:													
1911 to 1917	.5	.1	.6	.3	.1	.5	.62	.5	.4	.3	.4	.3	.1
For 1917	.5	1.2	2.3	1.7	1.0	1.0	.4	1.3	.9	.6	.6	.6	.4
Mean:													
1911 to 1917	3.5	4.0	4.2	4.0	3.8	3.9	3.7	3.2	2.8	2.6	2.5	2.9	3.43
For 1917	3.6	4.1	6.0	5.3	4.5	4.1	3.3	2.3	2.1	2.6	2.5	3.5	3.66

TEMPERATURE (° F.).

Absolute maximum:													
1907 to 1917	88.5	92	95.5	102	103	108	108	107	104	98	90	85	108
For 1917	86.0	92	90.0	94	100	102	106	107	98	97	86	85	107
Absolute minimum:													
1907 to 1917	12	13	17	32	39	56	60	56	41	24	15	15	12
For 1917	26	14	17	37	43	57	67	64	52	24	32	15	14
Mean:													
1907 to 1917	53	54	62	68	75	83	85	84	79	69	60	50	68.5
For 1917	53	56	63	69	72	83	85	85	79	67	62	49	68.6

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		° F.		° F.	*Days.*
1907	Feb. 8	29.0	Nov. 12	32.0	277
1908	Feb. 20	24.0	Nov. 14	29.0	268
1909	Feb. 25	30.0	Dec. 6	31.0	284
1910	...do....	26.0	Oct. 29	32.0	246
1911	...do....	29.0	Nov. 13	31.0	261
1912	Feb. 27	30.5	Nov. 2	29.5	245
1913	Mar. 17	26.0	Oct. 27	29.0	224
1914	Mar. 23	29.0	Nov. 20	31.0	242
1915	Mar. 22	24.5	Nov. 15	27.0	238
1916	Feb. 20	32.0	Nov. 14	29.0	268
1917	Mar. 5	17.0	Oct. 29	24.0	238

CROP CONDITIONS.

The season of 1917 was very unfavorable for crop production in the San Antonio region. The dry, cold winter resulted in much injury to winter crops, such as oats, field peas, flax, and all fruit crops. Field peas were severely injured by freezing, and early seedings of flax were killed. While oats survived the winter with good stands, freezing lessened greatly the amount of pasturage obtained from this crop, and the dry spring weather prevented their usual growth and development. Consequently, very low yields of both grain and oat hay were obtained.

Moisture stored in the soil from rains occurring in October and November, 1916, made possible the planting of Indian corn at the usual time in February, and reasonably good stands resulted. Sorghums were planted at the usual time in March, and on land prepared early in the fall of 1916 good stands were secured. Not much cotton was planted until after the rains which came the first part of May. Rapid growth of crops took place after the May rains until the moisture supply was exhausted. There was insufficient moisture for the best development of Indian corn and the sorghums, and low yields of these crops resulted. Rains the latter part of July came in time to be of benefit to cotton and forage crops. Owing to the extremely dry weather of the summer the Mexican cotton boll weevil was less serious than in the preceding few years, and cotton yields were fair. The total yields of sorghum for forage and Sudan grass were the lowest obtained since 1910.

ECONOMIC CONDITIONS.

The low yields of feed crops in 1917 and the high prices for feedstuffs combined to make the problem of providing sufficient feed for live stock most acute. This resulted in the sale of much live stock of all kinds and in efforts being made to import sufficient feed to carry over the remaining live stock, which consisted mainly of breeding animals and young stock. The high prices for cotton helped to offset to some extent the high prices for feed, because it made more money available for purchasing feedstuffs. It is believed that the exodus of live stock from the region may result in understocked ranges for some time and that there may be a shortage of work animals for crop production. On the whole, it may be said that economic conditions were fairly satisfactory, high prices offsetting to a large extent low crop yields.

The cultivated area is being extended gradually and steadily by the clearing of new lands, both as a result of the immigration of farmers to the region and the prospects for greater returns from farming.

ROTATION AND TILLAGE EXPERIMENTS.

The rotation and tillage experiments, which occupy 99 quarter-acre plats, were continued during 1917 without modification. The season of 1917 completed the ninth crop season for most of these experiments. A few of the rotations were started in 1913, so that from these only five years' results have been secured. Perhaps the most noticeable point brought out by the results in 1917 was the importance and value of stored moisture in a season of light precipitation during the growing period of the crops.

The average yields of all crops in the rotation experiments in 1917 were lower in all instances than the average yields of the same crops for the 9-year period from 1909 to 1917, inclusive. The yields of Indian corn, dwarf milo, oats for grain, and cotton were slightly higher than in 1916, while the yields of Sudan grass and sorghum for forage were considerably lower than in 1916. A comparison of the yields obtained in 1917 with those of 1916 serves to show the importance of favorable distribution of the rainfall and of stored soil moisture and the danger of correlating crop yields with the total annual precipitation. The total annual precipitation in 1916 was somewhat more than twice that of 1917, yet the yields of most crops were lower.

Table II shows the crops grown in the rotation experiments, the number of plats seeded to each crop, and the highest, lowest, and average yield per acre of each crop in 1917, as well as the average yields of the various crops for the 9-year period from 1909 to 1917, inclusive.

TABLE II.—*Yields per acre of crops in the rotation experiments at the San Antonio Experiment Farm in 1917 and average yields, 1909 to 1917, inclusive.*

Crop.	Unit of yield.	Average yield, 1909 to 1917, inclusive.	Yield in 1917.			
			Number of plats.	Average.	Highest.	Lowest.
Corn	Bushel	22.2	21	10.7	17.8	4.5
Dwarf milo	do	[a] 29.5	14	19.3	25.9	10.9
Oats for grain	do	11.6	8	6.6	15.0	3.3
Cotton	Pound	554.7	30	535.6	784.0	20.0
Sorghum:						
4.1-foot drills	Ton	4.13	5	2.56	3.38	1.96
8-inch drills	do	4.45	7	2.09	3.60	1.27
Sudan grass	do	[b] 5.35	2	3.14	4.20	2.07
Oats for hay	do	1.48	8	1.03	1.68	.59

[a] Six years. [b] Five years.

Though the results of these experiments continue to increase in value each year, it is still too early to draw very definite conclusions as to which particular rotations under trial are best suited to the conditions of the region. The results do indicate, however, the advantages of rotation with all crops being grown. Not only are

higher yields obtained from the various crops when grown in rotation, but observations on the experiment plats show the advantages of rotation in the control of weed pests and plant diseases. This is particularly true as regards the control of Johnson grass in uncultivated crops and the control of Texas root-rot in cotton.

The results obtained in 1917 brought out very strikingly the importance of early preparation in order to store moisture from rains occurring in the fall. Without the rains of October and November, 1916, and early plowing to facilitate the storage in the soil of the moisture from the rains, it would have been impracticable to plant corn and milo at the regular planting periods in 1917, and the average yields of all crops on the experiment farm probably would have been much less than those reported. Corn on land plowed in August of the preceding summer after corn yielded at the rate of 11.9 bushels per acre, while corn on land plowed in December after sorghum yielded at the rate of 4.8 bushels per acre. Cotton on land plowed in August after corn yielded at the rate of 592 pounds of seed cotton per acre, while cotton on land plowed in December after cotton yielded at the rate of 452 pounds of seed cotton per acre. The desirable effect of early preparation was also shown by the yields of other crops in the rotation experiments. This was particularly true in the case of sorghum for forage.

The practical application of the beneficial results from early preparation in 1917, as in previous years, is that whenever it is possible plowing or preparation for a crop should be done as soon as possible after the removal of the preceding crop. Such a practice not only results in higher yields, but is desirable from the standpoint of the distribution of labor. Early preparation also checks weed growth, and the clean fields make conditions less favorable for harboring various insect pests. While there may be years when early preparation does not result in increased yields, in a section such as the San Antonio region, where the precipitation is irregularly distributed and often inadequate, early preparation, to put the soil in the best condition to absorb any precipitation that may come, appears to be the safest and cheapest insurance of crop production.

EFFECT OF DIFFERENT TILLAGE PRACTICES.

The results bearing on certain tillage practices are sufficiently definite to make a summary of them of practical value. These results may be discussed under the following headings: Subsoiling, manuring, green-manure crops, biennial cropping, and the effect of rotation and tillage on root-rot in cotton.

Subsoiling.—The rotation and tillage experiments include a direct comparison as to the effect of subsoiling in preparation for various crops. There are four rotations in which the effect of subsoiling on

corn may be observed in comparison with four rotations which are the same except that subsoiling is not a part of the treatment; there are five rotations in which the effect of subsoiling on cotton may be observed and one each in which the effect of subsoiling on milo and oats may be observed. A detailed report on the effect of subsoiling on the yields of several crops in the rotation experiments was published several years ago.[1] The results obtained since that time corroborate the conclusions then published. The effects of subsoiling on the yields of different crops have been variable, increasing the yields slightly in some instances and decreasing them in others. In no case, however, has the increased yield been sufficient to compensate for the extra cost of subsoiling. The results obtained in 1917 indicate that subsoiling increased slightly the yields of corn, cotton, and oats for grain and decreased slightly the yields of Dwarf milo and oats for hay. Except in the case of oats for grain, these results are directly opposite to those obtained in 1916. In the 8-year period, 1910 to 1917, inclusive, the average yields of all crops except oats for grain have been slightly less on land subsoiled than on land not so treated. Generally speaking, the difference due to subsoiling has been insignificant.

Manuring.—The effect of manuring on crop yields has been tested in a number of the rotations. Wherever manure has been used it has been applied at the rate of about 16 tons per acre. A portion of the manure used has been that produced on the experiment farm, which is hauled from the corrals at frequent intervals and composted and later hauled to the field during the fall and winter. This manure is largely the droppings of work horses, with a small quantity from milk cows, and other waste material suitable for composting. The remainder of the manure used has been secured from near-by dairies. The manure from this source has been well rotted and has contained little straw or other coarse material, the practice in the locality being to keep dairy cows in corrals where no bedding material is used.

The effect of manure on the yields of crops has varied with the crop and season. Manure has shown more marked effects on land used continuously for the same crop than where crops are grown in rotation. It has had a more favorable effect on the yields of cotton than on those of corn and other crops. In none of the tests with manuring have the increased yields been sufficient as yet to justify the expense of the treatment.

In 1917 the average yields of corn and cotton were slightly increased by manuring, while the yields of milo and oats for grain were slightly decreased. When the average results for the 8-year period from 1910 to 1917 are considered, the average yields of crops

[1] Hastings, S. H., and Letteer, C. R. Experiments in subsoiling at San Antonio. *In* U. S. Dept. Agr., Bur. Plant Indus. Cir. 114, p. 9–14. 1913.

have been increased by manuring as follows: Corn, 0.9 bushel; milo, 7.2 bushels; and cotton, 59 pounds of seed cotton per acre. The average acre yield of oats for the same period has been 1.4 bushels less in rotations manured than in those not manured.

Green-manure crops.—Three different crop plants are being used as green-manure crops in the rotation experiments. Cowpeas and rye have been grown since the inauguration of these experiments in 1909, and field peas have been grown since 1913. Cowpeas are grown as a summer crop following oats, and field peas and rye are grown as winter crops. On account of drought during the summer, it has generally been impossible to grow crops of cowpeas following another crop. In only three years out of nine has it been possible to grow cowpeas after oats to a size sufficient to have any value for green manuring. It has not been possible to grow a crop of cowpeas during any season after the removal of a corn crop. On this account the growing of cowpeas has been discontinued in all rotations except two. In these two rotations cowpeas are planted after the oat crop is removed in May. Field peas were substituted for cowpeas in two rotations in 1913 and included in four new rotations started in that year, so that field peas are now grown on six plats each year. Rye is grown as a green-manure crop in one rotation.

Field peas planted in the fall of 1916 made reasonably rapid growth early in the fall, but were very severely injured by freezing during December. On account of the dry winter, subsequent growth was slow and the peas were entirely killed out by the freeze the first part of February. Consequently, there was practically nothing to turn under in the spring. Rye seeded on disked corn stubble survived the winter without injury, but did not grow very large on account of insufficient soil moisture. This crop was plowed under early in March, 1917. Cowpeas planted after oats in 1916 made a fair growth and were plowed under in November, 1916. No increase in yield of cotton on land where cowpeas were plowed under could be attributed to the treatment. Since practically nothing was turned under on those plats where field peas were grown, the effect of using field peas as a green-manure crop could not be studied in 1917. Cotton on land where rye was plowed under made 20 pounds per acre, the lowest yield of cotton in the rotation experiments. The land was so dry after plowing under the rye that the cotton made very little growth during the entire season.

The results with green manuring obtained to date indicate that cowpeas as a catch crop after corn or oats are not satisfactory, owing to dry weather during the summer and the inability to grow a crop regularly. Rye can ordinarily be grown as a winter crop, but it has had a very depressing effect on the yields of the succeeding crop. Field peas as a winter crop appear to be the most reliable crop for

green-manure purposes, and the best-adapted varieties are seldom injured seriously by freezing. However, the results obtained at the experiment farm do not show that crop yields have been increased perceptibly by plowing under any of the green-manure crops being used.

Biennial cropping and fallowing.—The results from biennial cropping and fallowing in 1917 were similar to those obtained in previous years except 1916. There was practically no difference in the yields of corn, oats, and sorghum on biennially cropped land and on land cropped annually to the same crops. The yield of seed cotton was approximately 25 per cent less on biennially cropped land than on land cropped annually. The average yields of corn and cotton for the 7-year period from 1911 to 1917, inclusive, have been less on biennially cropped land than on land cropped annually, while the average yield of oats for grain for the same period has been greater on biennially cropped and fallowed land than on land cropped annually. With the exception of oats, the yields of crops in 1917 and the average yields for the 7-year period from 1911 to 1917 were less on both biennially cropped and annually cropped land than the average of all plats used in the rotation experiments for each crop.

Effect of rotation and tillage on root-rot in cotton.—In previous reports attention has been called to the effect of rotation and tillage practices on the spread of root-rot in cotton. Root-rot is one of the most serious problems with which farmers in the San Antonio region have to contend. It not only does much damage in cotton fields, but also attacks many other plants, notably alfalfa and nearly all fruit and ornamental trees. It has been found in the rotation experiments that root-rot is less serious in cotton grown in rotation with other crops, such as corn, sorghum, or oats, than where the same land is used continuously for cotton production. Each year since 1913 counts of the total number of cotton plants on each plat and of the number which died from root-rot on each plat have been made.

Root-rot was less extensive on the rotation plats in 1917 than in 1916, when it was more widely distributed on the experiment farm than in any other season. Cotton is the only major field crop grown in the rotation experiments that is susceptible to root-rot. The percentage of cotton plants on the different plats which had died from root-rot by the end of the season in 1917 varied from none to 43.7 per cent of the total number of plants, while in 1916 practically 100 per cent of the plants on two different plats died from root-rot. Even on plats cropped continuously to cotton, and which therefore were on the same soil areas as in 1916, there was much less extensive root-rot infection in 1917 than in 1916. It has been assumed that root-rot spreads gradually from an infection center and increases in severity from year to year. Observations made in 1917 on plats

cropped successively to cotton show that the root-rot infected areas do not necessarily occur in the same locations as in previous years. These observations are being aided by the making each season of a chart showing accurately the location of the root-rot infected portions of each row of cotton. These charts are drawn to scale, and a comparison of the chart of a plat can be made with the chart of the same plat in any other year. This charting of root-rot areas was started in 1916. When charts for a large number of years are available a study of them may result in important information concerning the spread of root-rot infection and its behavior.

Observations made and the data recorded concerning root-rot infection on the various rotation plats again showed the advantage of practicing crop rotation in the control of this disease in so far as it affects cotton. On a plat that had been cropped successively to cotton for nine years 43.7 per cent of the plants were dead from root-rot on October 25, while on a plat in a 3-year rotation of oats, cotton, and Dwarf milo only 1.9 per cent of the plants had died from root-rot. These two plats are situated directly across the road from each other, are on the same type of soil, and it seems reasonable to believe that the difference in root-rot infection was due chiefly to the cropping system that has been practiced.

While our present knowledge of root-rot and its control is decidedly inadequate and future results may change present indications, it seems that, in the absence of any better means of control, rotation of crops and early preparation of the land are to be recommended. It may be expected that from a continuance of the present rotation experiments additional information on the nature and control of this disease will be obtained.

EXPERIMENTS WITH COTTON.[1]

The cotton experiments which for a number of years have been conducted in cooperation with the Office of Crop Acclimatization and Adaptation Investigations were continued. They consisted of acclimatization studies of varieties from Mexico, Central America, Africa, and Asia, tests of local varieties, and cultural experiments.

Although the season was unusually dry, the yields of cotton recorded were very satisfactory. This may be accounted for by the fact that boll-weevil damage was much less severe than usual. The drought probably was the chief factor in limiting the amount of damage done by the weevils, but the rather irregular treatment of these fields appears to have been a contributing factor. It was necessary to replant most of the cotton experiments on May 16, owing to the nonuniform stands secured from the first planting, so that the

[1] This report was furnished by Mr. P. V. Cardon, of the Office of Crop Acclimatization and Adaptation Investigations of the Bureau of Plant Industry.

only cotton far enough advanced to attract the hibernated weevils was located on a far side of the station. Even there it was not until August, after the late July rains made conditions more favorable for the weevils, that they became numerous. Then, with a view of preventing a normal increase in their numbers and thus reducing the possibility of an early migration of weevils to the late-planted fields, the punctured squares on the early-planted cotton were gathered at frequent intervals and destroyed. By the time weevils appeared in the late-planted cotton most of the bolls on the lower parts of the plants were matured and many of those on the higher fruiting branches were too far advanced to be seriously injured.

Some breeding work was done with varieties from foreign countries, and selections were made from a number of promising big-bolled cottons, especially Acala and Kekchi, which appear to be well adapted to the conditions of soil and climate obtaining at San Antonio. Acala is a Mexican variety with lint measuring $1\frac{1}{8}$ to $1\frac{3}{16}$ inches in length, and Kelchi is a Guatemalan variety with lint even longer than that of Acala. Both of these varieties were introduced and acclimatized by the Department of Agriculture.

In a test which compared Acala with Triumph and Lone Star, two common varieties of the Texas big-boll type, all these varieties gave approximately the same yields. Acala proved to be earlier and slightly more prolific, but the bolls were somewhat smaller, and consequently there was no significant difference in the yield of seed cotton. However, a report from the Bureau of Markets showed that the lint of Acala was of greater length, averaging $1\frac{1}{8}$ inches, while that of Lone Star and Triumph averaged only 1 inch.

The results recorded from the repetition of a time-of-thinning test with Lone Star were very similar to those obtained in 1916. The experiment consisted of 80 rows, 4 feet apart, 264 feet long. This field was divided into two sections (A and B), making 80 rows 132 feet long in each. Thinning was commenced at the north end of section A and the south end of section B, five rows being thinned to approximately 8 inches every three days. The first blocks were thinned on May 22, when the seedlings were so small that the cotyledons were just shedding their seed coats; the last blocks were thinned on July 6, when the plants were 12 to 18 inches high and already flowering. The dry season again had the effect of stunting the growth of the plants in the crowded late-thinned rows, so that the yields were less than in the rows that were thinned early. Even in these rows there was only a slight development of vegetative branches, on account of the dry weather.

A test was included in the cultural experiments to determine the effect of different rates and dates of planting cotton. Commencing on March 17, six rows 240 feet long were planted every 10 days

until May 25, two rows at each of these rates—16, 24, and 32 pounds per acre. The plants were thinned to about 14 inches when they had two or three true leaves. The results of this test indicate that a heavy rate of seeding is advisable where early planting is practiced, while with later planting a lighter rate probably will suffice. The greater amount of seed planted early tends to offset the effects of a low percentage of germination and injury to the seedlings by sudden extreme changes of temperature. Increased yields were obtained from those blocks seeded at the highest rate until April 16, doubtless because of the fact that better stands were secured on these blocks. The blocks planted April 16 having comparable stands gave approximately the same yield per block regardless of the rate of seeding. These blocks also gave the maximum yields of all blocks except the block seeded at 32 pounds per acre on April 5, which yielded approximately the same. All blocks planted after April 16 showed a decrease in yield with the advance in the date of planting.

To secure further data regarding the yield and quality of lint with an equal number of plants per acre in rows at varying distances apart, an experiment begun in 1915 was repeated. The results were contrary to those obtained in 1915, being similar to the results secured in 1916. The row yield increased with the distance between rows, but the greater yields of the wider spaced rows were not sufficient to offset the smaller number of rows per acre, the acre yield increasing with the number of rows per acre.

EXPERIMENTS WITH CORN.

WORK OF THE OFFICE OF CORN INVESTIGATIONS.[1]

The experiments of the Office of Corn Investigations in 1917 at the San Antonio Experiment Farm were a continuation of adaptation studies with varieties of widely different characters and further tests of interplanting early and late maturing varieties as a method of increasing yields.

Seedings were made February 28 and March 1. There was very little moisture in the soil at that time and that not evenly distributed. As a result germination was not uniform, some hills coming up promptly, while others were not showing four to five weeks after seeding. Dry weather continued through March and April, but during the first two weeks of May the precipitation amounted to 2.38 inches. This afforded sufficient moisture to make practicable the seeding over of the experiments.

May 16 the original seedings were plowed out and a second seeding made. A rainfall of 0.96 of an inch on May 19 brought about rapid

[1] This report was furnished by Mr. E. B. Brown, of the Office of Corn Investigations of the Bureau of Plant Industry.

and uniform germination. This rain was followed by two months of almost rainless weather, the precipitation totaling but 0.61 of an inch, 0.48 of an inch of this amount falling on one date, July 4. On July 20 there was a rainfall of 2.12 inches, followed on the next day by 0.78 of an inch. These rains were succeeded, like that of May 19, by about two months of nearly rainless weather, the total precipitation from July 22 to September 17 being only 0.39 of an inch. Such unfavorable conditions resulted, as would be expected, in almost complete failure of the crop.

Mention has been made in previous reports that in the experiments at San Antonio the yields have been determined largely by the amount of rainfall occurring at the time the corn is beginning to shed pollen. In this connection it is interesting to note that the only varieties that succeeded in making a few ears of representative size were those that were beginning to shed pollen when the rains of July 20 and 21 occurred.

Under the severe conditions of drought that prevailed, none of the varieties made a profitable yield, the best yield not exceeding a few bushels per acre of corn of poor quality. With such results there is little choice as to varieties. Some differences, however, were observable. The check variety, Laguna, and a few other varieties of the same length of growing season (including some of the prolific varieties from the Southeastern States) made a few ears. Very early maturing varieties and varieties later in maturity than the check made no grain, or, at the best, but a few small nubbins. Best among the varieties earlier than Laguna were Brazos White, Pelinque, and Texas Surecropper. These varieties made a few short ears, with grain of fair quality.

TEXAS CORN GROWERS' ASSOCIATION VARIETY TEST.

A large number of varieties of corn were planted in a variety test for the Texas Corn Growers' Association in 1917. On account of the unfavorable conditions none of the varieties made a yield of any consequence, and the results of the test were of very uncertain value.

CORN IN WIDE-SPACED ROWS.

Planting corn in rows farther apart than the ordinary distance has been advocated as a desirable practice for semiarid regions. In certain sections the planting of a row of cowpeas between the wide-spaced corn rows has been practiced. The result of an experiment bearing upon this problem was reported in 1915.[1] An experiment similar to the one reported upon in 1915 was made in

[1] Hastings, S. H. The work of the San Antonio Experiment Farm in 1915. U. S. Dept. Agr., Bur. Plant Indus., West. Irrig. Agr. Cir. 10 [Misc. Pub.], 17 p., 2 fig. 1916.

1916, but on account of the severe drought the corn was a total failure on all plats, and the results were of no consequence.

The experiment in 1917 consisted of four plats, 264 feet long. The rows varied from 4.1 feet to 7 feet apart on the different plats. An attempt was made to have the same number of plants per acre on the different plats; that is, the plants in the wide-spaced rows were left sufficiently close together to accomplish this. Practically this result was not attained. On account of the dry weather which prevailed, no cowpeas were planted between any of the rows in 1917. Table III shows the results obtained in this experiment.

TABLE III.—*Yields of corn in a wide-spaced row experiment at the San Antonio Experiment Farm in 1917.*

Plat.	Distance between—		Plants per acre.	Average yield.		
	Rows.	Plants.		Per row.	Per plant.	Per acre.
	Feet.	*Inches.*		*Pounds.*	*Pounds.*	*Bushels.*
No. 1	4.1	22	5,672	18.60	0.131	10.63
No. 2	5.0	21	4,868	25.75	.175	12.14
No. 3	6.0	21	4,208	16.15	.106	6.34
No. 4	7.0	18	4,024	16.85	.099	5.68

In a similar experiment in 1915 there appeared to be a distinct advantage in the wide-spaced rows, the yields from those 7 feet apart being 10 bushels, or about 40 per cent greater than from the rows 4 feet apart. The results in 1917 do not show the same advantage in favor of the wide-spaced rows, the yields being decidedly less than in either the 4 or 5 foot rows. There appears to be no definite reason for the much lower yields from the wide-spaced rows, unless it is due to the thinner stand or local soil or moisture conditions.

EXPERIMENTS WITH SORGHUMS.

Seed of a number of varieties of both grain and forage sorghums was furnished by the Offices of Cereal Investigations and Forage-Crop Investigations for making a variety test in 1917. Owing to the fact that no land with sufficient soil moisture to permit uniform germination of the seed was available at planting time in the spring, the variety test was not started at that time. After the rains the latter part of July it was thought advisable to seed the varieties, in order to determine the length of time necessary for maturing a crop in the fall and to study the effect of the sorghum midge on late-planted sorghums. All of the varieties were seeded on July 26 on a portion of field D3, which was in Sudan grass pasture the previous year and had been fallow since being plowed in October, 1916. Good stands of all varieties were obtained. The following varieties were

used in the test: Dwarf milo, C. I. No. 332; feterita, C. I. No. 567; feterita, S. P. I. No. 22329; Dwarf kafir, C. I. No. 340; Manchu kaoliang, C. I. No. 171; kaoliang, C. I. No. 309; Schrock kafir, S. P. I. No. 1518; Dwarf hegari, S. P. I. No. 1539; Sweet kafir, S. P. I. No. 32707; Darso sorghum, S. P. I. No. 1530; Whooper sorghum, F. C. I. No. 5873; Schrock kafir, from Roy Schrock, Enid, Okla.; and Acme broom corn, C. I. No. 243.

No rains of any consequence came after seeding until September 18. From September 18 to 21 a total of 1.66 inches of precipitation was recorded. However, during this long dry period all of the sorghums continued to make some growth on the moisture stored in the soil. A killing frost occurred on the morning of October 29, the minimum temperature being 24° F. This killed all the sorghums to the ground. It was therefore necessary to harvest immediately. This frost was about two weeks earlier than frost is ordinarily expected at San Antonio. The Dwarf milo, feterita, kaoliang, and Darso sorghum were practically fully matured. The kafirs were in the milk stage and would have required about 10 days or two weeks more to reach maturity. Most of the kafirs were fairly well filled, but were not sufficiently mature to make thrashing desirable. Dwarf milo was the only variety in which there was enough seed to make thrashing advisable. The feterita had been almost completely ruined by birds, and the kaoliang had produced very little seed. The Dwarf milo yielded at the rate of 10 bushels of grain per acre. Sweet kafir made the highest yield of forage.

Practically no midge injury could be observed on any of the varieties. Very little midge injury was noticeable at any time during the season. The sorghums in the rotations, though rather late, escaped midge damage entirely. Repeated searches for midges were made during the season. On October 2 a few were found at work on sorghum growing on field B4, which was planted early in July. The indications were that the midge had been at work for several days on this sorghum, to which considerable damage was done.

EXPERIMENTS WITH FLAX.

Experiments in growing flax[1] as a winter crop at the experiment farm were first begun in 1914. Sufficiently favorable results were obtained from the preliminary seedings to encourage more extensive experiments. In 1916 a series of experiments, including variety tests in both field plats and nursery rows and a date-of-seeding test, was started. While the yields of flax in 1916 were rather low, the results, considering the very unfavorable conditions for all winter crops,

[1] This work was conducted in cooperation with Mr. C. H. Clark, of the Office of Cereal Investigations of the Bureau of Plant Industry.

were encouraging. It was therefore thought desirable to continue the work on about the same basis in 1917.

The flax work done during the winter of 1916–17 consisted of variety tests in field plats and nursery rows and a date-of-seeding test. Several selections made from Smyrna flax (C. I. No. 30) in 1916 were also seeded. In the variety test, 6 varieties were seeded in tenth-acre plats and 12 varieties in 16-rod nursery rows 16 inches apart. All varieties were seeded the first time on November 18. All of these seedings were severely injured by freezing during December and were killed out entirely by a later freeze, which occurred on February 1. After observing the extensive damage to the flax by freezing in December, it was thought advisable to make another seeding. On January 2, 6 varieties were seeded in thirtieth-acre plats, as there was not sufficient seed for larger plats. The flax seeded at this time was severely injured by the freeze on February 1, which resulted in thinning the stand greatly but not in killing all the plants. The varieties used in this test and the results secured are shown in Table IV.

TABLE IV.—*Yields of flax varieties in thirtieth-acre plats at the San Antonio Experiment Farm in 1917.*

Variety.	C. I. No.	Estimated stand at harvest.	Average height.	Grain per acre.
		Per cent.	*Inches.*	*Bushels.*
North Dakota Resistant No. 114	13	35	22	2.68
Damont	3	20	22	2.41
Fargo common	18	20	22	2.41
Smyrna	30	20	18	3.48
Williston Golden	25	30	12	2.14
Select Riga	2	30	22	2.95

The conditions at the time of seeding were favorable for germination, and the poor stands were due entirely to injury from freezing.

Date-of-seeding test.—North Dakota Resistant No. 114 (C. I. No. 13) and Damont (C. I. No. 3) were used in a date-of-seeding test in thirtieth-acre plats. The reason for using two varieties was that the variety was changed after the first seeding had been made. The seeding dates and results from this test are shown in Table V.

TABLE V.—*Yields of flax in a date-of-seeding test at the San Antonio Experiment Farm in 1917.*

Variety.	C. I. No.	Date of seeding.	Stand at harvest.	Height.	Grain per acre.
			Per cent.	*Inches.*	*Bushels.*
North Dakota Resistant No. 114	13	Nov. 6, 1916	0	.....	.....
Damont	3	Nov. 18, 1916	0	.....	.....
Do	3	Dec. 3, 1916	5	20	0.80
Do	3	Jan. 2, 1917	40	20	4.02
Do	3	Jan. 21, 1917	60	18	5.36

The highest yield was obtained from the seeding made on January 24. This was doubtless largely due to the better stand at harvest and would indicate, in case of frost damage to early-seeded flax, the possibility of reseeding even as late as the latter part of January.

While the results obtained with flax in 1917 were unsatisfactory, it is not thought desirable to condemn the crop for the San Antonio region. In the preceding three years when flax was grown encouraging results were obtained, and certain varieties withstood the winter temperatures with very little injury. The winter of 1916–17 was very severe, and many plants commonly grown in the region were badly injured by the low temperatures.

EXPERIMENTS WITH BEAN VARIETIES.

Much interest in the planting of beans for human food was shown by farmers in 1917. Recommendations for planting in 1917 were made on the basis of preliminary results obtained at the experiment farm in previous years. To ascertain the probable yield of beans which might be expected, six of the most common kinds were selected for planting in a variety test. On account of the dry weather prevailing early in the season, the beans were not planted until May 9. Six rows 264 feet long and 3 feet apart were planted to each variety. The experiment was made on field B4, where the land had grown corn in 1916 and had been plowed in the fall. It was in good tilth, and the rains early in May supplied moisture to the surface soil. Germination was rapid, and good stands of all varieties were obtained. The following varieties were used in the test: California or Mexican Pink, pinto, tepary, and navy, and Whippoorwill and Blackeye cowpeas. No more rain came until late in July and the beans consequently suffered from drought. The plants of California Pink, pinto, and navy beans began to die on the appearance of hot, dry summer weather, and all plants were dead before the rain came late in July. The tepary beans and Whippoorwill cowpeas, though suffering from drought, survived with practically no loss in stand. The Blackeye cowpeas had produced a light crop by the middle of July, but neither the tepary beans nor the Whippoorwill cowpeas had set fruit. The tepary beans took on new vigor after the rains in July and produced a light crop of beans late in the fall. The Whippoorwill cowpeas made a fair vine growth, but produced very little seed. The yields of seed per acre from these three varieties were as follows: Tepary beans, 156 pounds; Blackeye cowpeas, 166 pounds; and Whippoorwill cowpeas, 30 pounds.

These results indicate the inadvisability of planting California Pink, pinto, or navy beans in the San Antonio region unless they can be planted so early that they will reach maturity before the hot, dry

weather of summer. California Pink or pinto beans should be planted in March in the San Antonio region, or they may be planted late in July, so that they will mature during fall weather. For extreme conditions of drought the Blackeye cowpea appears to be the best variety tested, and the indications are that the tepary bean is also of value for such conditions.

HORTICULTURAL EXPERIMENTS.

The horticultural experiments consist of testing varieties of fruits, methods of culture for fruit crops, the testing and acclimatization of foreign fruit and nut trees likely to be adapted to local conditions, and the testing of various plants suitable for stocks on which to bud or graft the improved varieties.

The season of 1917 was very unfavorable for all fruit crops. A freeze on March 5, when the minimum temperature was 17° F., killed the small fruit of all varieties of peaches and many other plants. At this time all the peaches had flowered and many were in full leaf. This freeze resulted in killing to the ground the figs, olives, pomegranates, and all citrus plants except citranges. In the history of the experiment farm pomegranates had never before been so severely injured. The Rusk citrange was the least injured of the varieties of citranges. The injury to this citrange consisted in freezing back the growing branches several inches, and practically a complete failure of the fruit crop resulted.

Numerous additions were made to the horticultural plantings in 1917. They consisted mainly of fruit and ornamental plants recently introduced by the Office of Foreign Seed and Plant Introduction of the Department of Agriculture. Several varieties of peaches, plums, almonds, apricots, jujubes, and persimmons were among the additions.

The growing conditions during the spring and summer of 1917 were not good for fruit or ornamental trees. Owing to the dry winter, very little moisture had been stored in the soil available for the trees. Consequently, trees of all kinds made very poor growth, and many trees died from causes resulting directly or indirectly from drought. It was necessary to haul water several times to irrigate the young trees set out in the spring, which otherwise would have been unable to survive.

The only horticultural crops which fruited on the experiment farm in 1917 were jujubes, two varieties of plums, and a few figs. None of the varieties of peaches, apricots, grapes, almonds, olives, or persimmons produced any fruit. This was the first year that all varieties of persimmons had failed entirely to fruit. For the first time *Pyrus betulaefolia*, S. P. I. No. 21982, an introduction from

China, produced a heavy crop. This fruit is of no value, and the principal interest in the species rests on the possibility of its making a valuable stock for fruits like the apple and pear.

One of the seedling date palms, which was planted in 1907, matured dates for the first time. Several of the date palms flowered in 1915, but attempts at fertilization resulted in failure. In April, 1917, fertilization of the date flowers was accomplished and a large number of fruits set. The fruit was of rather inferior quality, with large seeds and a small proportion of pulp, and it would be classed as a semidry date. An illustration of the date palm, showing the bunches of fruit, is shown in figure 2.

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FIG. 2.—Seedling date palm on the San Antonio Experiment Farm, showing the crop of dates in 1917.

Rather extensive plantings of ornamentals were made on the three acres of land added to the farm in 1915. These plantings consisted both of species already growing on the older station grounds and of several species not previously grown at the station. A large number of ornamentals were received from the Office of Foreign Seed and Plant Introduction, most of which were planted in the greenhouse or in the nursery, as they were rather small for transplanting to permanent locations.

EXPERIMENTS IN ROOT-ROT CONTROL.

In 1916 experiments were started to determine the effect of the chemical treatment of the soil on the prevention of root-rot in cotton. Observations on the occurrence of root-rot had indicated that it is generally more serious and widespread on highly calcareous, alkaline soils than on soils with a lower lime content. This led to the belief that possibly some means of counteracting the alkaline conditions by the addition of acid substances might be effectively employed to prevent root-rot infection. Commercial acid phosphate and calcium acid sulphate were the materials used. Several areas which were known to be badly infected with root-rot were selected for the tests in 1916. These were located on fields A3, C5, and AB8. The most extensive experiment was located on field AB8, while those on the other fields were supplementary to it. The area on field AB8 was divided into nine equal-sized plats. The tests were made in triplicate; that is, three plats were treated with acid phosphate, three with calcium acid sulphate, and three were not treated. Acid phosphate and calcium acid phosphate were both applied immediately before seeding, at the rate of 1,000 pounds per acre. The arrangement of the plats, with the treatment received, is shown in figure 3.

Calcium acid sulphate.	Untreated.....	Acid phosphate.
Acid phosphate.....	Calcium acid sulphate..	Untreated.
Untreated.....	Acid phosphate.....	Calcium acid sulphate.

FIG. 3.—Arrangement of plats in the root-rot prevention experiment on field AB8 at the San Antonio Experiment Farm in 1916 and 1917. Each plat was 29 by 100 feet.

Observations were made on the cotton at frequent intervals during the season to determine whether the treatments would affect the time of appearance or the extent of root-rot infection. At the end of the season, counts of the stands, the number of plants affected by root-rot, and the yields of seed cotton on the various plats were re-

corded. A diagram of the entire area, showing the affected portions of each row, was made. A study of all of the data recorded in connection with the observations made showed that the treatments had no effect in reducing the extent of root-rot infection or on the yields of the crop. Acid phosphate was used in the tests on fields A3 and C5, and the same results were observed as in the experiments in field AB8.

It was thought that possibly the full effect of the acid treatment was not realized in 1916, owing to the dry weather prevailing subsequent to applying the treatments and the consequent failure of the acid to go deep into the soil. It was decided, therefore, to continue the work on field AB8 in 1917, using the same plats, treatments, and crop. The treatments were applied in 1917 just before seeding the cotton. The same observations were made and the same data secured at the end of the season as in 1916. The results in 1917 were the same as the previous year. Root-rot was widespread over the entire area and no difference in the extent of the infection could be attributed to the treatments. It was noted, however, that the acid-phosphate treatment had apparently increased the yield of seed cotton slightly.

An effort to determine the depth at which root-rot infection takes place was made in 1917. Since cotton does not become affected until late in the season, usually August, it has been thought that the root-rot infection may gain entrance to the plant through the roots after they descend to a considerable depth. The root-rot infected area on field C5 was used for this study. Six areas, 8 by 16 feet, were selected where the cotton was badly infested with root-rot in 1916. The soil was removed from three of these areas to depths of 18, 32, and 48 inches, respectively, and hauled away from the field. These excavations were then filled in with soil hauled from a field which had not been cropped for several years and which was assumed to be free from root-rot infection. The soil from the remaining three areas was removed to depths corresponding with the first three and after lying out for two or three days was returned to the excavation from which it was removed in as nearly the same arrangement as removed; that is, each foot section was returned to the same depth from which it was removed.

It was expected that this would afford opportunity to determine the depth at which the root-rot infection takes place and show the effect of aeration on the root-rot fungus. The excavations were made in February, 1917, and the handling of the soil dried and loosened it. The rainfall subsequently was not sufficient to moisten the soil to any extent or to cause it to settle back into place. The rains in May were sufficient to germinate the cotton seed, but the cotton grew very little and was only a few inches high at the end of the season. No root-rot

developed on any of the areas where the soil was removed and new soil hauled in, while considerable root-rot developed adjacent to these areas. Owing to the small size of the plants on these excavated areas and the shallow rooting of the cotton, it is not considered safe to conclude that the treatment prevented the development of root-rot. Cotton will be planted on the same areas in 1918 and an opportunity given to study further the effects of the excavation. Two plants were dead on each of two of the areas where the same soil was returned to the excavations after aeration.

A preliminary experiment to test the effect of mulches on root-rot in cotton was made on field C5. Areas on which the cotton had died from root-rot in 1916 were selected for this test. Oat straw and coarse manure were used for making the mulches. Each mulched area covered two middles between three rows and was of variable length, depending upon the extent of the root-rot infected areas. The mulches were put on July 12 and 13. At this time the cotton was about 8 or 10 inches high and had put on very few bolls. Observations made throughout the remainder of the season did not indicate that either straw or manure mulches had any effect upon the development of root-rot in cotton.

The effect of treating the soil with acid phosphate on root-rot in alfalfa was observed in the nursery on field A3. Four plats were used in this experiment. Two were treated with acid phosphate at the rate of 1,000 pounds per acre, and two were untreated. The treatment was applied just before seeding alfalfa in December, 1916. A very good stand was obtained. The alfalfa was irrigated several times during the summer of 1917. The plants began to die from root-rot in June, 1917, and continued to die throughout the summer. No beneficial effect from the application of acid phosphate could be observed.

EXPERIMENTS IN CROP UTILIZATION.

Certain features of the work pertaining to crop utilization reported upon in 1916 were continued in 1917. The steer-pasturing experiment, the principal object of which was to ascertain the value of winter oats and Sudan grass for pasturing beef cattle, was continued. The same two animals were used and the same crops and methods of management and feeding were employed. At the beginning of the experiment the steers (fig. 4) were about 2 years old and weighed approximately 875 pounds each. They were in fair condition of flesh.

Oats.—Two acres were seeded to winter oats on October 24, 1916, on field C4. This land had been in corn in 1916 and was plowed in September. The rains early in October had put the land in good condition for seeding, and a good stand was obtained. Another

rain in November was of much benefit to the crop, and by December 19 the oats were several inches high and were large enough to start pasturing. A severe freeze occurred at this time, which froze back the oats several inches and delayed starting pasturing for several weeks. By January 24 the oats had again grown to be 6 to 8 inches high, and pasturing with the two steers was started. The 2 acres were fenced into two pastures and the steers were changed from one pasture to the other as necessary. On February 1 the oats were again frozen back somewhat. On February 23 the oats had been eaten very close and were making practically no growth on account of drought. It was necessary, therefore, to remove the steers from the pasture, and they were put in the dry lot and fed

FIG. 4.—Steers used in the oat-pasturing experiment on the San Antonio Experiment Farm. (Photographed in February, 1917.)

Johnson grass hay. During the period the steers were on oat pasture, from January 24 to February 23, they gained 96 pounds, or at the rate of 1.6 pounds each per day.

On April 11 the oats had again grown to about 8 inches in height and were beginning to head, and the two steers were turned into the field. The oats headed very short and appeared to be suffering from drought. The steers were changed from one pasture to the other as necessary until the oats were entirely eaten down and had become dry. The steers were removed on June 7. During the 58-day period from April 11 to June 7 the two steers made a total gain of 147 pounds, or at the rate of 1.26 pounds each per day for the period.

During the two periods the steers were on the oat pasture they made a total gain of 243 pounds in weight, or the gain for the season was at the rate of 121.5 pounds per acre. If this gain is valued at 9 cents per

pound, the oat pasture was worth $10.94 per acre. While this return is rather low, yet considering the adverse conditions of the season, such as drought and severe frost injury, and the labor economies in such a method of handling the oats crop, the net returns would be fully as great as if the oats were allowed to mature for hay or grain.

Sudan grass.—On March 27, 1917, two acres of Sudan grass were seeded on field D3. The land had been in milo the preceding year and was plowed in October, 1916. The soil was rather dry at the time of seeding, and as there was no rain for several weeks only a small proportion of the seed germinated immediately. After the rains came in May a large proportion of the seed germinated, which thickened the stand materially. The two acres were fenced into two pastures, to make possible the changing of the animals from one pasture to the other as necessary, in order to permit the grass to make growth.

On June 7, when the steers were removed from the oat pasture, the Sudan grass was very uneven in growth, some plants being 4 feet tall and heading out and some not more than 12 inches high. The steers were put on the Sudan grass pasture on that date. Owing to the drought the Sudan grass made very little growth, and by July 10 the steers had eaten the grass close in both pastures with the exception of a few clumps which had headed and become so dry that the animals would not eat them. The steers were therefore removed to the dry lot. In order to give the Sudan grass an opportunity to make even growth subsequently, both pastures were gone over with the mower to cut the scattering clumps of dry grass. The grass was weighed after curing, the total from the two acres being 1,438 pounds of cured hay, or at the rate of 719 pounds per acre. During the period of 33 days from June 7 to July 10 the two steers made a total gain of 136 pounds, or each gained at the rate of 2.06 pounds per day.

The steers were returned to the Sudan grass pasture on July 25 and remained until August 28, when it was necessary to remove them, since the grass had been eaten very close again. During the above period of 33 days the two steers gained a total of 106 pounds, or each gained at the rate of 1.60 pounds per day.

The steers were then kept in the dry lot and fed Johnson grass hay until September 24, when they were put again on the Sudan grass pasture. They were removed on October 8, which completed the pasturing for the season. During this last period the steers lost a total of 6 pounds.

During the three periods the steers were on Sudan grass pasture they made a total gain of 236 pounds from the two acres, or at the rate of 118 pounds per acre. In addition to the pasturage furnished, hay at the rate of 719 pounds per acre was harvested. If the gain in weight is valued at 9 cents per pound, the Sudan grass pasture was worth $10.62 per acre. This is considered scarcely an adequate

return for an acre of Sudan grass, even under the conditions prevailing in 1917, since this grass should have yielded nearly 2 tons per acre if it had been allowed to mature and had been cut for hay.

On account of the necessity for changing the animals from pasture to dry feed several times during the season, it is difficult to determine definitely the value of the pasturage. The animals kept in good condition throughout the entire period and when sold in San Antonio in November, 1917, topped the market by a good margin. When the animals were fed on hay in the dry lot they made slow gains, and near the end of the period they sometimes lost slightly in weight. Therefore, the gains made on dry feed were rather expensive. When the animals had sufficient pasturage, either oats or Sudan grass, very satisfactory gains were made. It appears, though, that the oats make a little more satisfactory pasture crop than Sudan grass. However, these two supplement each other, one being a winter and the other a summer crop. The results for the two years in which pasturing has been done indicate the value of these crops when used for pasturing beef cattle to be nearly, if not quite, as great as if any other use were made of the crops. The advantage of utilizing these crops for pastures on farms or ranches located long distances from market is important. It seems undesirable to keep animals for very long periods on high-priced hay, as was done in this experiment. This could probably be avoided by the use of silage made from drought-resistant crops, such as the sorghums, by the use of native pastures, or by using cottonseed products and native prickly pear during those periods when pasture from the crops was not available.

Approved:

WM. A. TAYLOR,
Chief of Bureau.

MAY 16, 1918.

"YOU WILL REALIZE, as I think statesmen on both sides of the water realize, that the culminating crisis of the struggle has come and that the achievements of this year on the one side or the other must determine the issue. It has turned out that the forces that fight for freedom, the freedom of men, all over the world as well as our own, depend upon us in an extraordinary and unexpected degree for sustenance, for the supply of the materials by which men are to live and to fight, and it will be our glory when the war is over that we have supplied those materials and supplied them abundantly, and it will be all the more glory because in supplying them we have made our supreme effort and sacrifice."—*From President Wilson's Message to the Farmers' Conference at Urbana, Ill., January 31, 1918.*